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THOMSON SCATTERING FROM TWO SPECIES LASER-PRODUCED PLASMAS

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We report on observations of two separate ion acoustic waves in a plasma composed of a heavy (Au) and of a light (Be) species with Thomson scattering. The experiments are performed with the Nova laser facility at the Lawrence Livermore National Laboratory. The plasma is produced by illuminating a flat disk (2 mm diameter, 51 μm thick), which is coated with Au and Be multilayers of varying thickness (typically 0.5 nm Au and 5 nm Be with a total thickness of 2.5 μm), with one of the Nova beams. We used a 1 ns square pulse with 2.7 kJ energy at 3ω (λ = 351.1 nm) and a probe laser operating at 2ω (λ = 526.6 nm) with varying energies in a 4 ns square pulse. Ion acoustic waves belonging to both species, Au and Be, were detected spectroscopically by Thomson scattering at a distance of 250 μm and 500 μm from the disk. For very small Au concentrations of 1 % of total ion density the narrow ion feature of the Thomson scattering signal shows a central peak from scattering on electrons bunched in the Debye sphere of Au ions in addition to the ion acoustic waves belonging to the species of the main plasma ions (Be). Increasing the amount of the heavy species (Au) of the mixture plasma by increasing the relative Au concentration of the target, results in a larger ion acoustic velocity of the heavy species. For a mixture of 4 % Au, 96 % Be two separate ion acoustic waves, one belonging to Au, one belonging to Be ions, are observed. By further increasing the amount of Au to 10 % total density the ion acoustic waves are no longer separated. They mix so that broad ion acoustic features are obtained. These results verify theoretical prediction for phase velocities and damping of ion acoustic waves in mixture plasmas.

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